Oroville FERC Relicensing (Project No. 2100)

Environmental Work Group

July 28, 2004

SP-F10 Task 2B

Evaluation of Potential Effects of Oroville Facilities Operations on Spawning Chinook salmon SP-F10, Task 2B

Need for Study

- **Operation of Oroville Facilities May Affect:**
  1) **Water Temperature**
  2) **Instream Flow**
  3) **Water Surface Elevation**

- **May Affect Spawning Chinook Salmon**

Study Objective

Evaluate the Potential Effects of Project Operations on Spawning Chinook salmon.

Objectives were accomplished by collecting and analyzing:

- Carcass Survey Data

  - September 5, 2000 through December 14, 2000

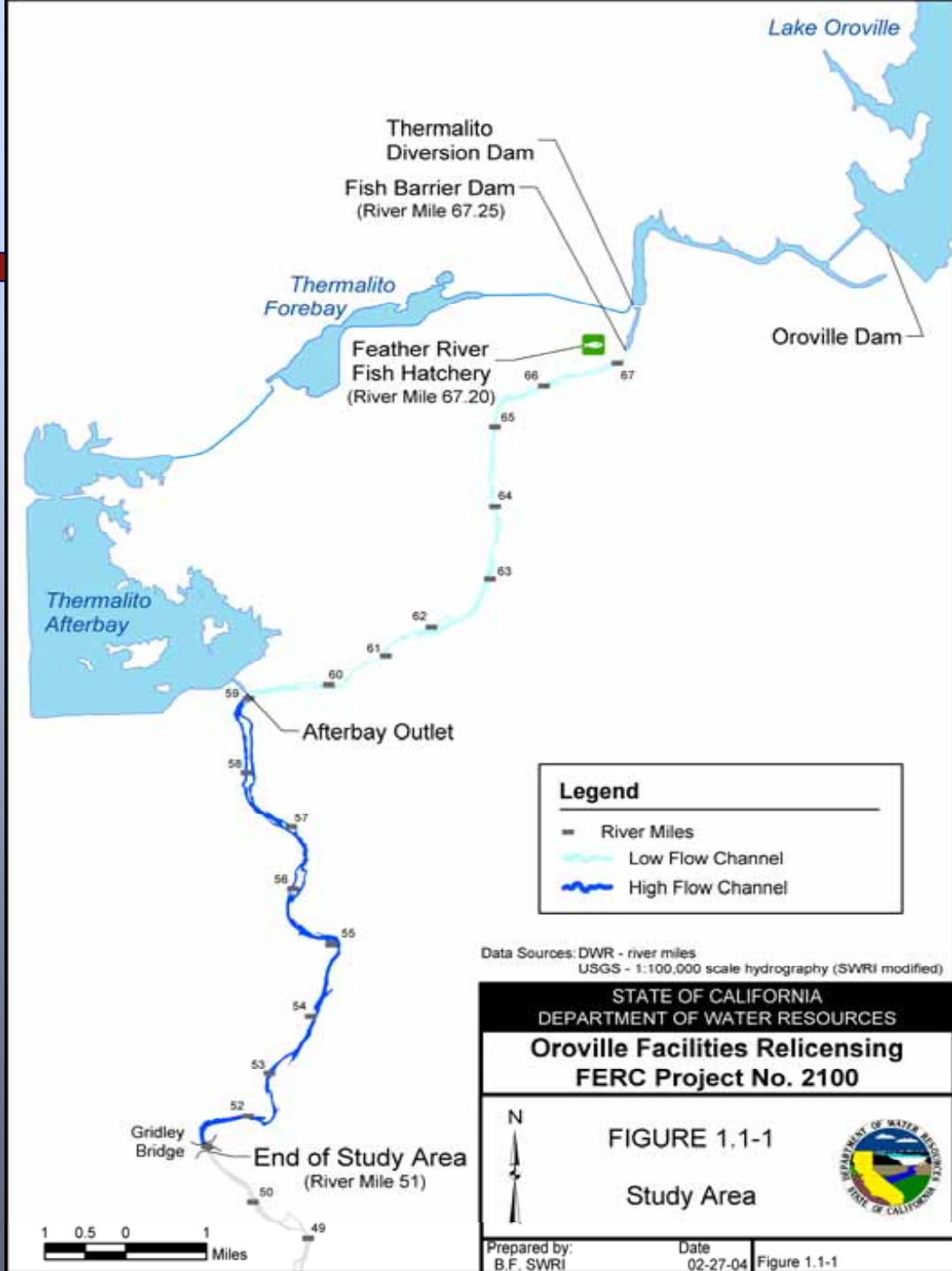
  - September 10, 2001 through December 13, 2001

  - September 3, 2002 through December 19, 2002

  - September 2, 2003 through December 17, 2003

Study Area

- **Lower Feather River from the Fish Barrier Dam (RM 67) to Gridley Bridge (RM 51)**



Methodology

Variables Evaluated

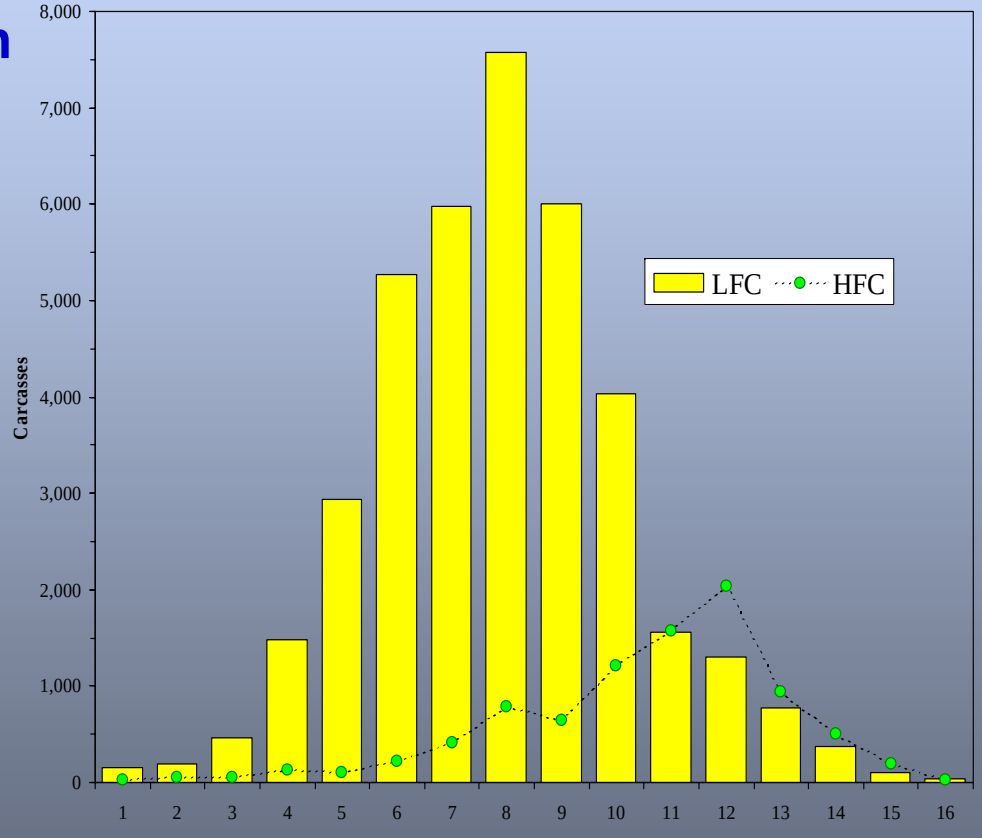
- **Spatial and Temporal Spawning Distribution**
- **Water Temperature During Spawning**
- **Pre-Spawn Mortality**
- **Spawning Escapement**
- **Superimposition**

- **Results Were Similar Among Years and Among Variables**
- **For Purposes of This Presentation, Results from the 2002 Carcass Survey Were Used as an Example**

Results

Spatial (LFC, HFC) and Temporal Spawning Distribution

- **Carcass Counts Were Much Higher in the LFC**
- **In the LFC**
  - October 14-31, Highest
  - October 21-25, Peak
- **In the HFC**
  - November 11-21, Highest
  - November 18-21, Peak

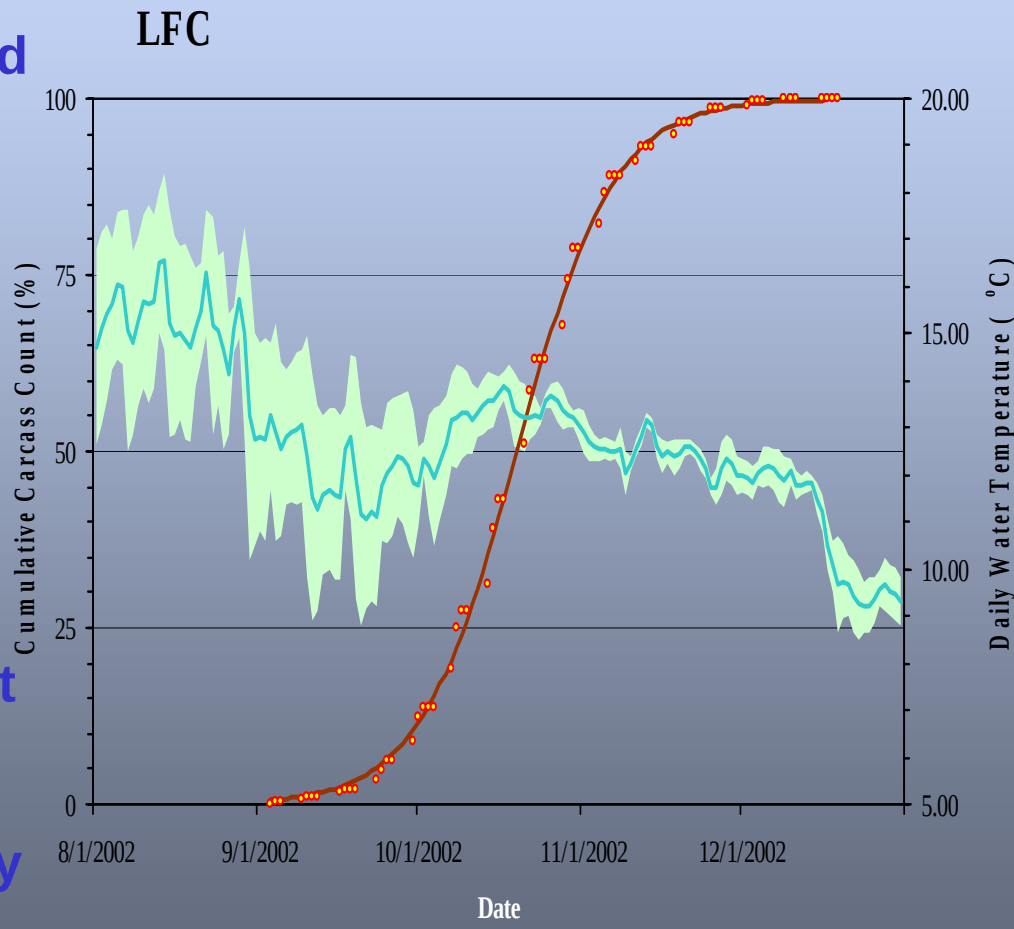


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
From	9/3	9/9	9/16	9/23	9/30	10/7	10/14	10/21	10/28	11/4	11/11	11/18	11/25	12/2	12/9	12/16
To	9/5	9/12	9/19	9/26	10/4	10/10	10/17	10/25	10/31	11/8	11/14	11/21	11/27	12/5	12/11	12/19

Results

Water Temperatures In the LFC During The Spawning Period

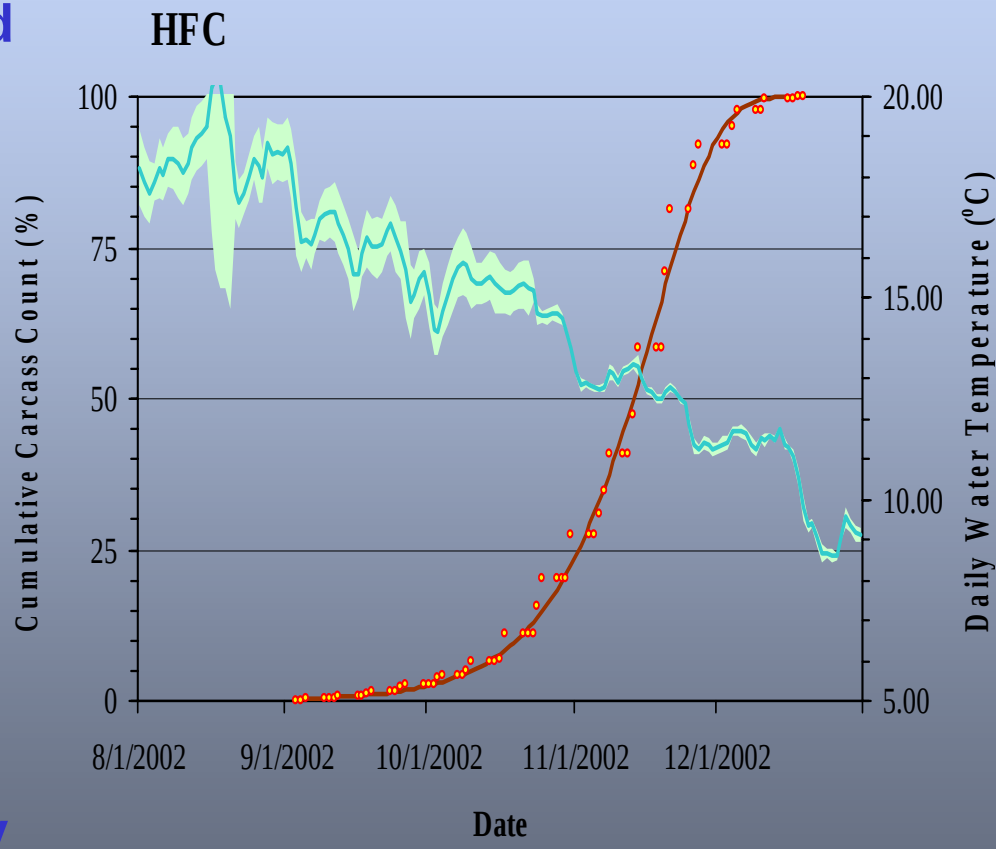
- **Water Temperature Ranged From 9ºC (48ºF) to 15ºC (59ºF) During Most Of the Spawning Period**
- **Water Temperature Negatively Correlated With Time (R^2=0.55)**
- **Approximately 100 Percent of Carcass Distribution Occurred When Mean Daily Water Temperature was <15ºC (59ºF)**



Results

Water Temperatures In the HFC During The Spawning Period

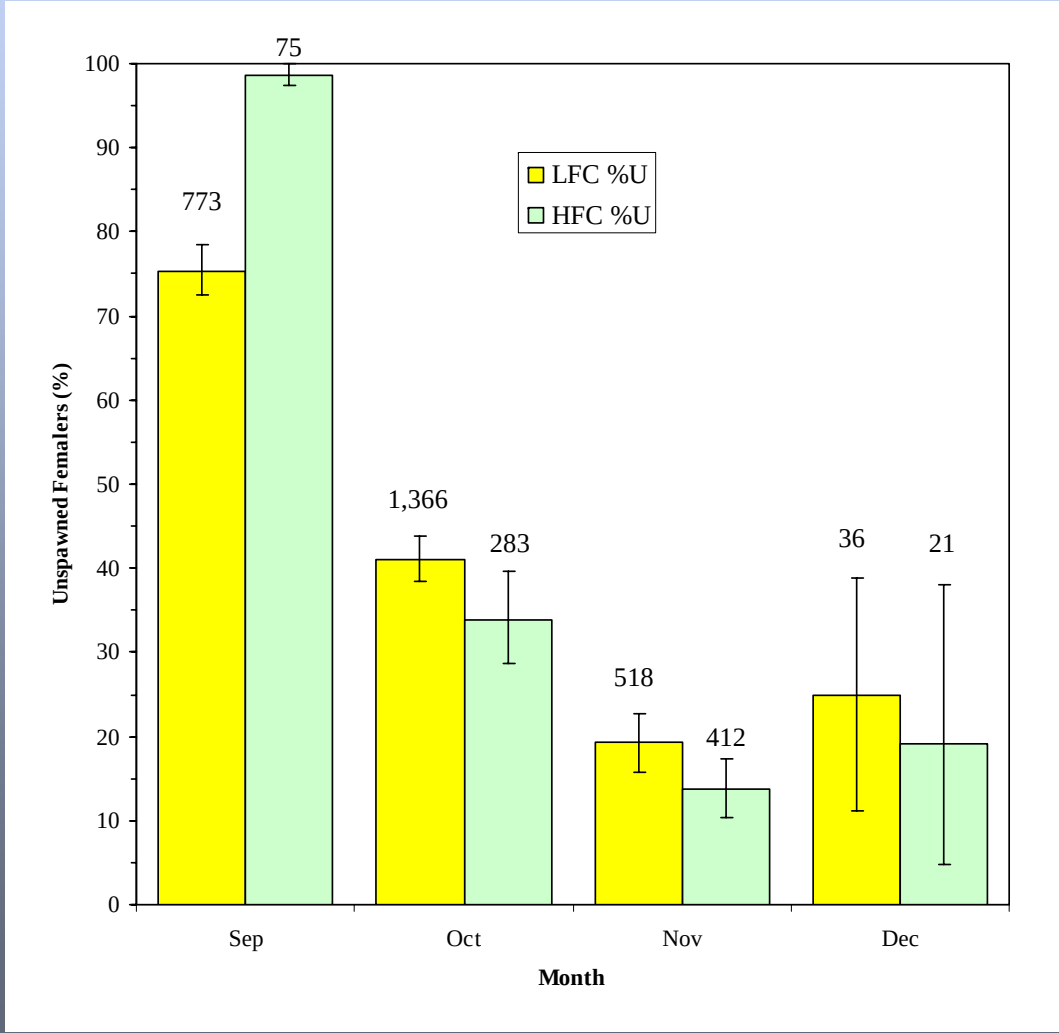
- **Water Temperature Ranged From 9ºC (48ºF) to 19ºC (66ºF) During Most Of the Spawning Period**
- **Water Temperature Negatively Correlated With Time (R^2=0.95)**
- **Approximately 90 Percent of Carcass Distribution Occurred When Mean Daily Water Temperature was <15ºC (59ºF)**



Results

Pre-Spawn Mortality Estimates

- **Estimates Generally Decreased through Time**
- **Estimates Highest in September: LFC=75% HFC=98%**
- **Estimates Highest in LFC October through December**



Results

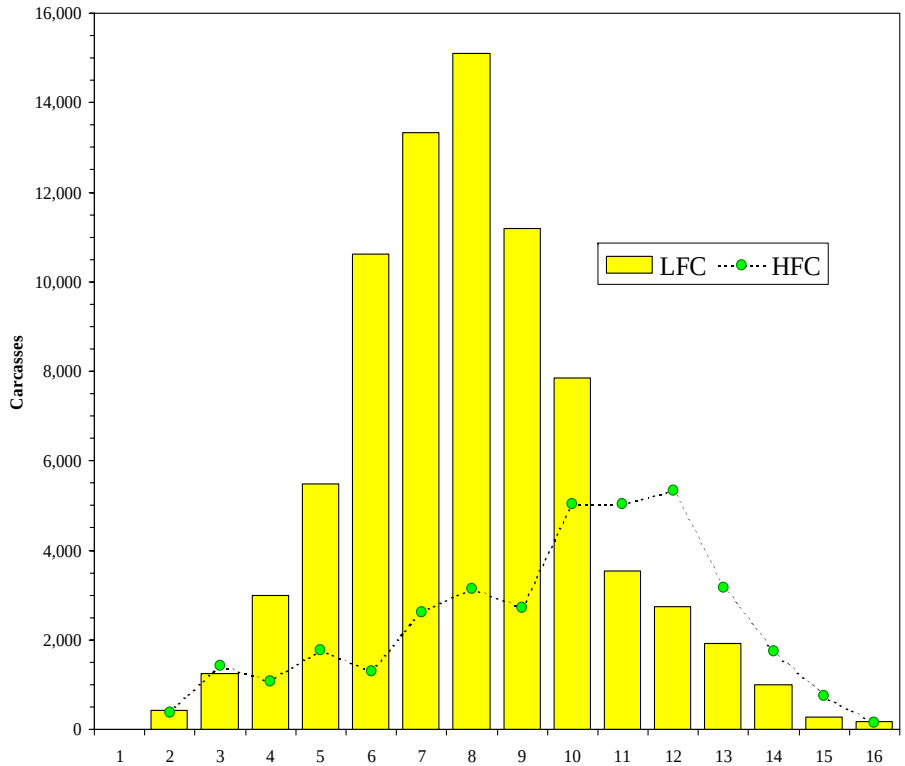
Annual Pre-Spawn Mortality Estimate Summary 2000, 2001, 2003

	LFC	HFC
2000	33%	39%
2001	51%	39%
2003	46%	39%

Results

Spawning Escapement Estimates

- **Weekly Escapement Estimates Were Much Higher in the LFC**
- **In the LFC**
  - October 14-31, Highest Range 11,500-15,500
  - October 21-25, Peak
- **In the HFC**
  - November 4-21, Highest Range 5,000-5,500
  - November 18-21, Peak



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Annual Spawning Escapement Estimates 2000 through 2003

	LFC	HFC
2000	73,416	43,508
2001	117,072	78,049
2002	70,952	34,115
2003	58,468	39,600

Results

Superimposition Index Values

- 1995 Values From Sommer et al. 2001

Year	Reach	Escapement Estimate	Spawning Area ft^2	Sex Ratio	Redd Area ft^2	Superimposition Index
1995	LFC	44,111	773,732	0.50	55	1.57
1995	HFC	15,572	915,089	0.50	55	0.47
2003	LFC	58,468	509,384	0.36	55	2.28
2003	LFC	58,468	509,384	0.50	55	*3.16*
2003	HFC	39,600	688,361	0.49	55	1.54
2003	HFC	39,600	688,361	0.50	55	*1.58*

Discussion

Spatial and Temporal Spawning Distribution

- **In 2002, 81 percent of Carcasses Detected in LFC (Spatial)**
  - Water Temperatures in LFC Generally Cooler
  - Hatchery Operations
    - More Efficient Hatchery Operation: Increased Survival of Juveniles, Increased Escapement
    - Salmon of Hatchery Origin Stronger Behavioral Attraction to Locations Adjacent to Feather River Hatchery
    - Genetic Introgression: Spring-run Traditionally Ascend to Uppermost Riffles
- **In 2002, Spawning Began and Peaked Later in the HFC (Temporal)**
  - Available Literature Suggests Spawning Initiated When Water Temperatures are Near 60^{o}F and Accompanied by Decreasing Water Temperature Trend
    - Temporal Spawning Distribution and Water Temperature Were Consistent With This “Theory”

Discussion

Pre-Spawn Mortality

- High Water Temperature During Immigration, Holding, and Spawning
- Disease
- High Spawning Escapement
  - Escapement Estimates from 2000 through 2003 are Some of the Highest Recorded
  - Many Mortality Causing Factors are Density Dependent
  - More Stressed at Higher Population Levels, Thus More Likely to Die from Other Stressors
- Recreational Angling
- Combining All Years and Both Reaches, Pre-Spawn Mortality Ranged From 70-100 Percent from September 2 through October 4
  - Feather River Hatchery Designates All Adult Salmon Arriving up to October 1 as Spring-run Chinook Salmon

Discussion

Spawning Escapement

- High Spawning Escapement Estimates from 2000 through 2003, When Compared to Historical Levels, May be A Function of:
  - Favorable Ocean and Instream Conditions
  - More Successful Hatchery Techniques
  - Better Management of Instream Conditions
  - Different Methodologies Used to Calculate Estimates
  - Unequal Sampling Effort Among Years

Discussion
Superimposition

- The Increase in Superimposition From 1995 to 2003 May be a Function of:
  - Increased Spawning Escapement
  - Decreased Available Spawning Habitat
  - Different Methodologies Used to Calculate Estimates
  - Genetic Introgression (More So In the LFC)